

Single Event Transients in Low Voltage Dropout (LVDO) Voltage Regulators

**C. Poivey¹, H. Kim¹, C. Seidleck¹, K. LaBel²
J. Karsh², S. Pursley², I. Kleyner², R. Katz²,
S. Pursley²**

¹ MEI Technologies

² NASA - GSFC

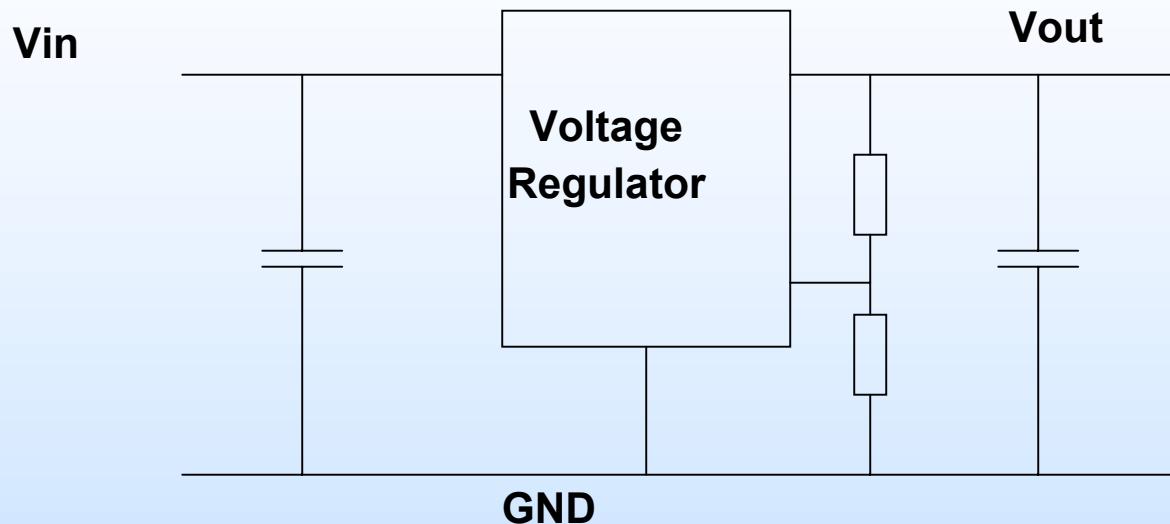


Outline

- **Background**
- **Summary of recent test results**
- **Mitigation**
- **Conclusion**



Background



- **Voltage regulators are sensitive to heavy ion induced Single Event Transients (SET)**
 - SET amplitude is generally small (<1-2V) because of large output capacitors used in typical applications



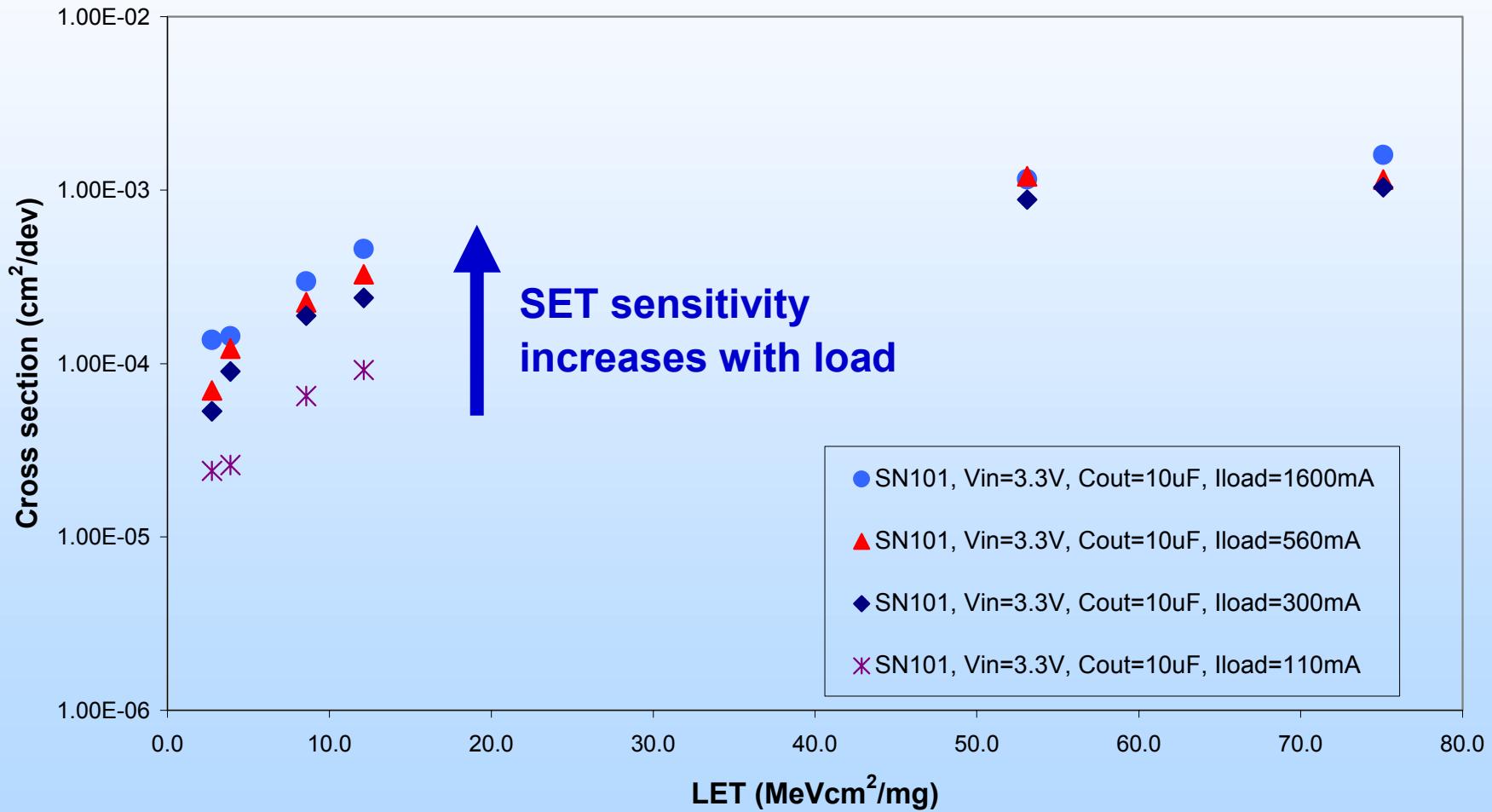
Background

- **SET in voltage regulators are a concern for low voltage applications (< 5V)**
 - Overvoltages may cause destructive conditions
 - Undervoltages may cause functional interrupts and electrical latch-up conditions
- **SET in 1.5V voltage regulators are critical for FPGA RTAXpower supply applications**
 - DC core absolute max rating = 1.6V
 - 1.5V core supply voltage recommended operating conditions: 1.425V min, 1.575V max
- **Summary of results on test candidates for 1.5V voltage regulators**
 - RHP4913, STM
 - MSK5900, MS Kennedy
 - Discrete design, Space Power Electronics

<http://radhome.gsfc.nasa.gov>



RHLP4913

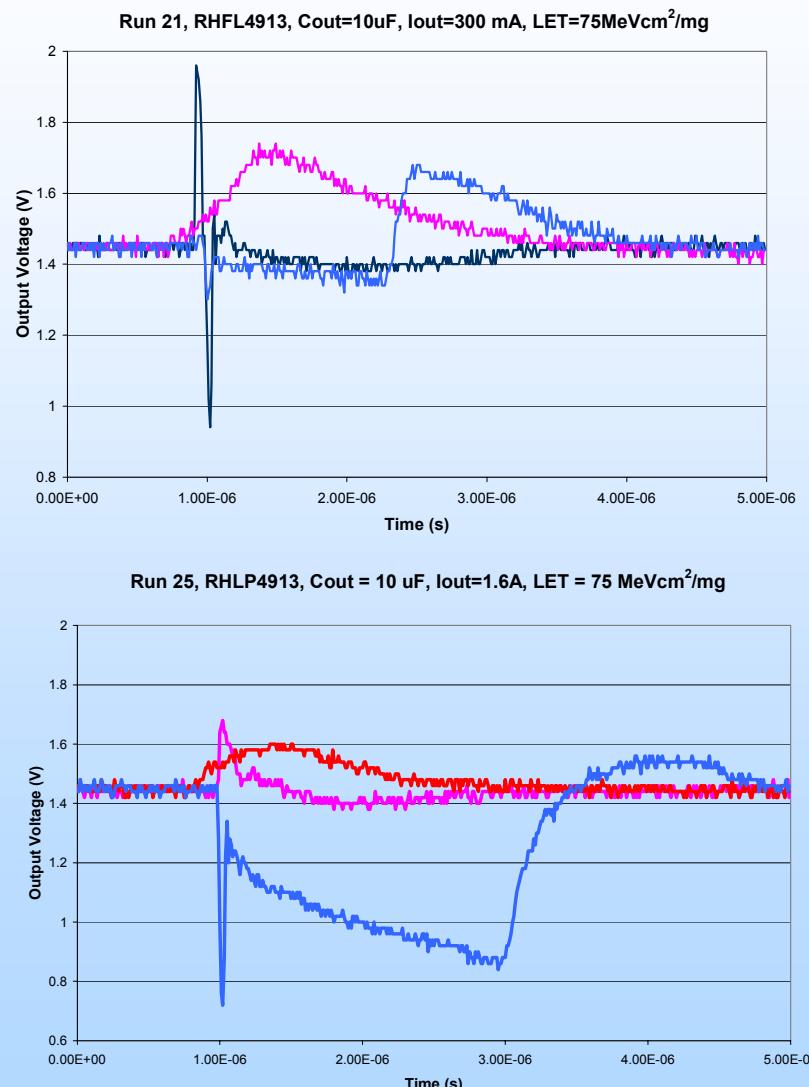
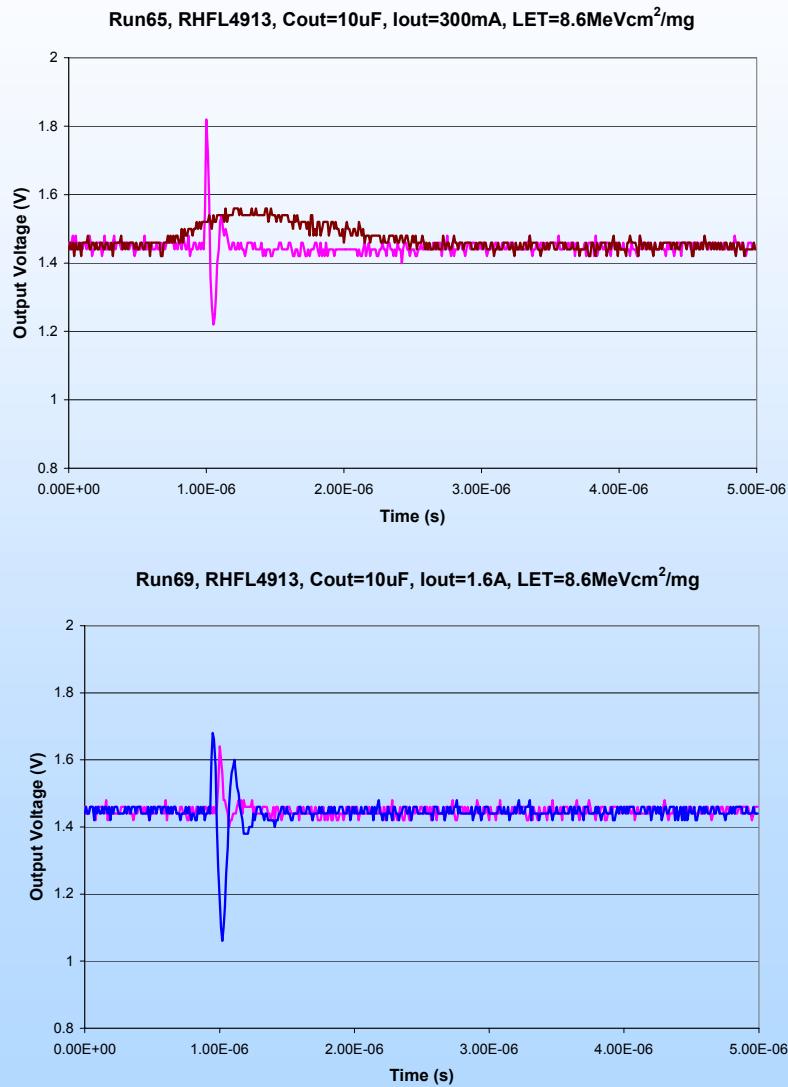


RHLP4913, Typical SETs, Cout=10 μ F



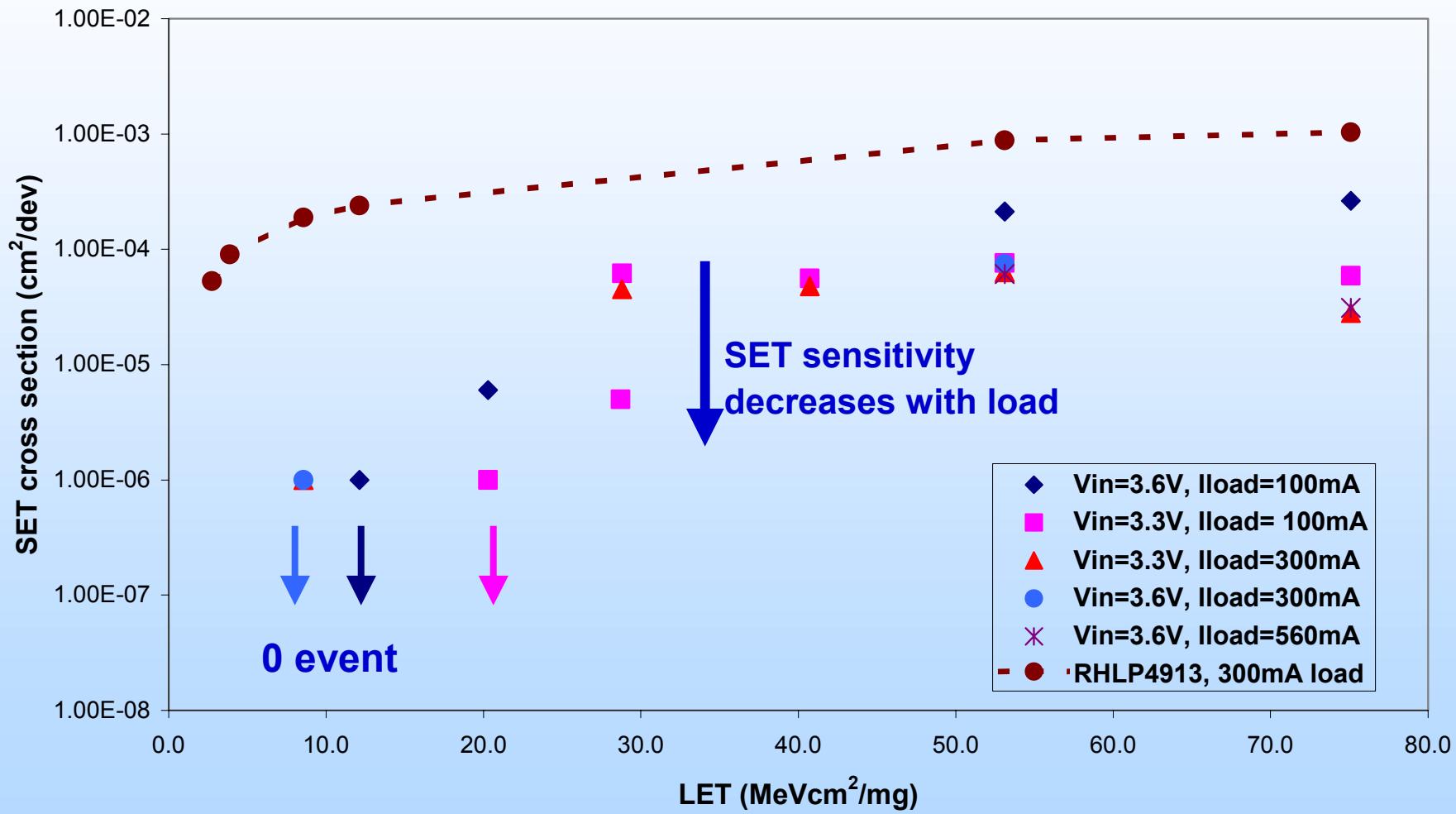
LET

lout





MSK5900

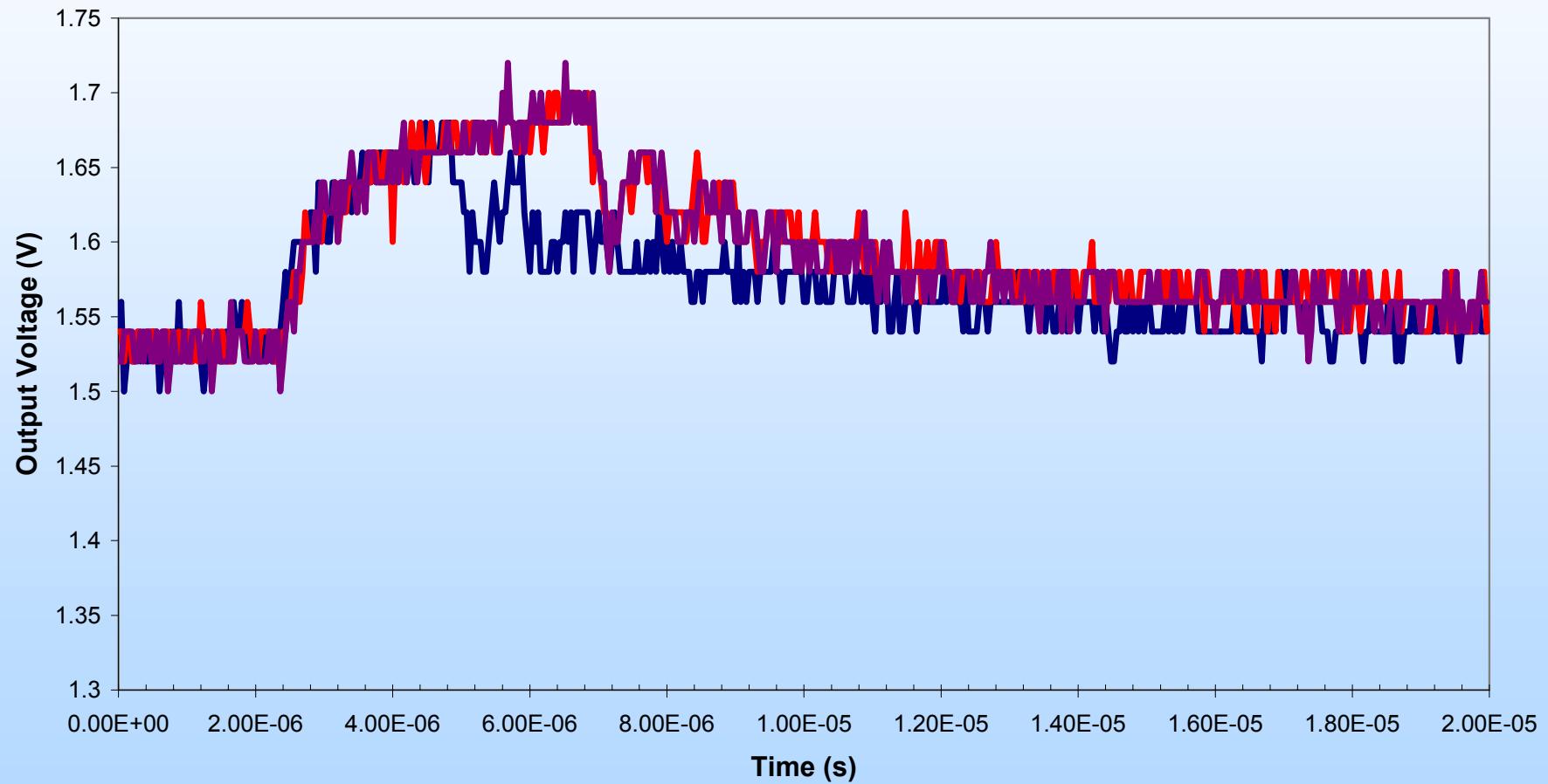




MSK5900, Typical SETs

Cout = 44 μ F

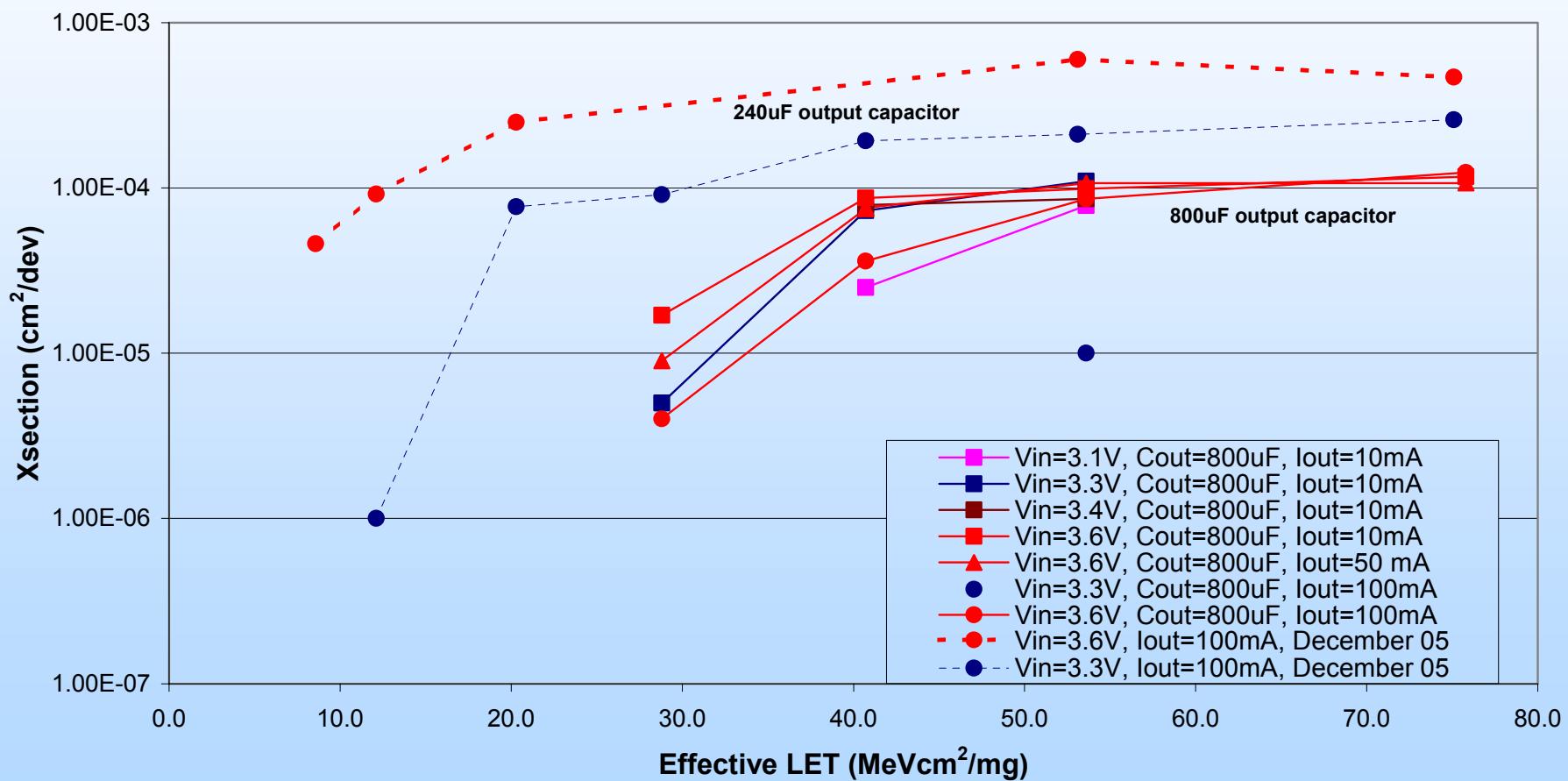
MSK5900, Run 275, LET=53.1 MeVcm²/mg, Vin=3.6V, Iload=100 mA





Mitigation, Cout Discrete Design

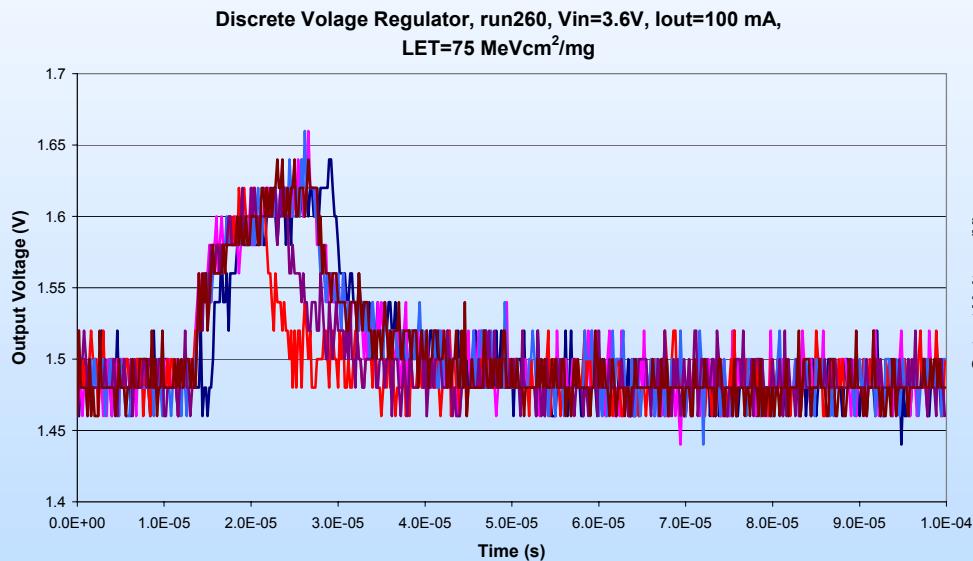
Discrete Voltage Regulator



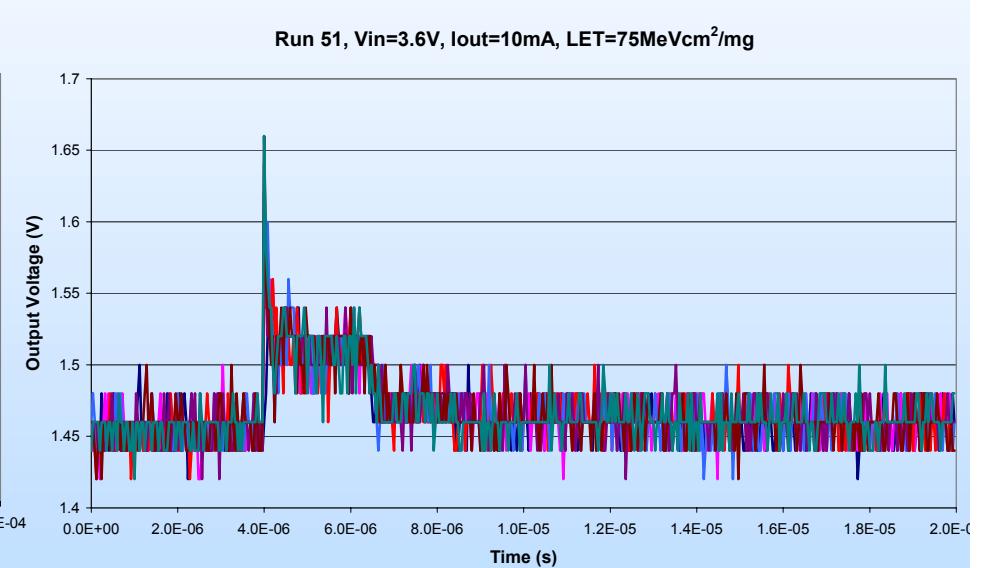


Mitigation, Cout, Discrete Design SET waveform

Cout=240 μ F

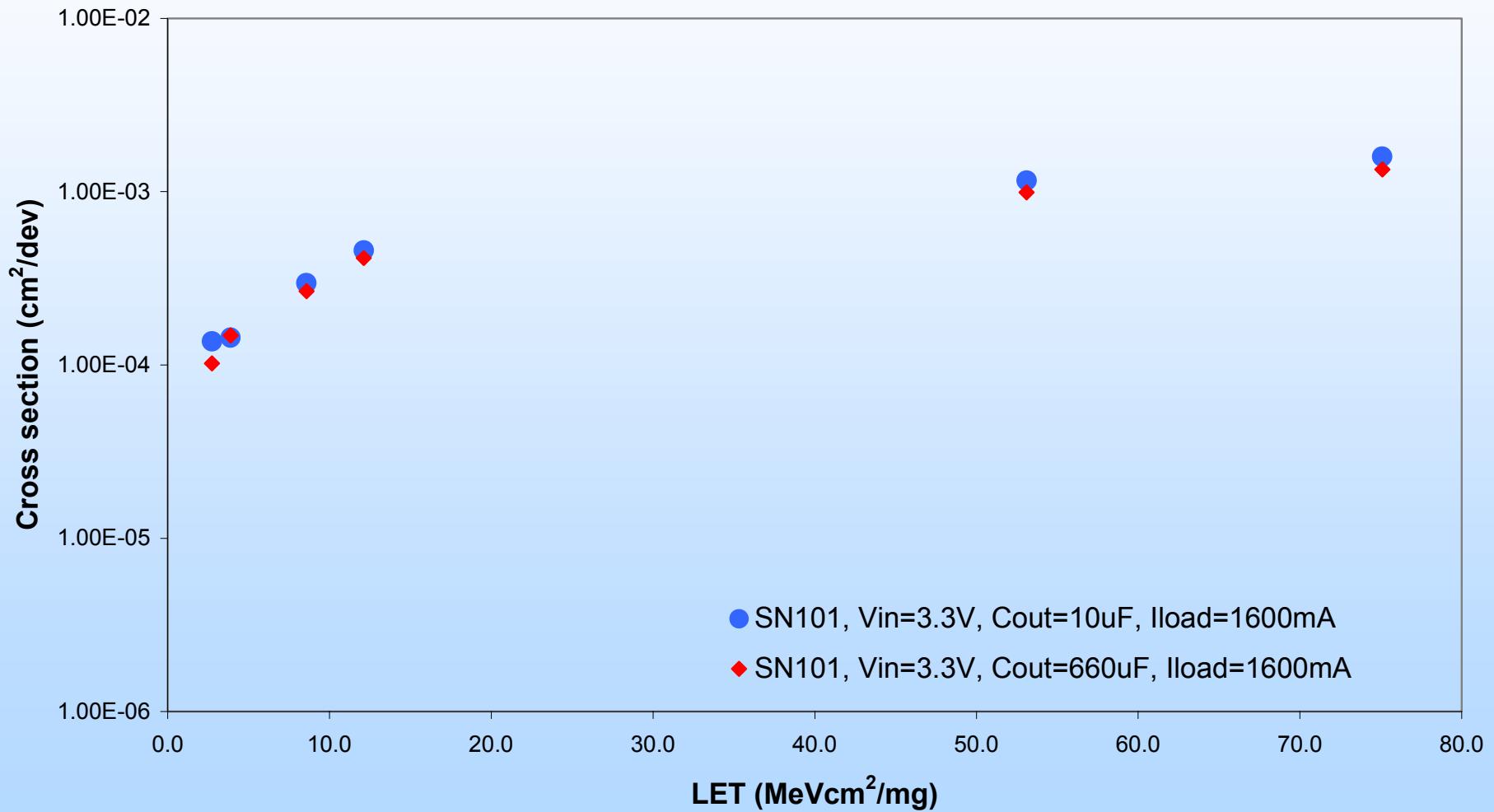


Cout=800 μ F





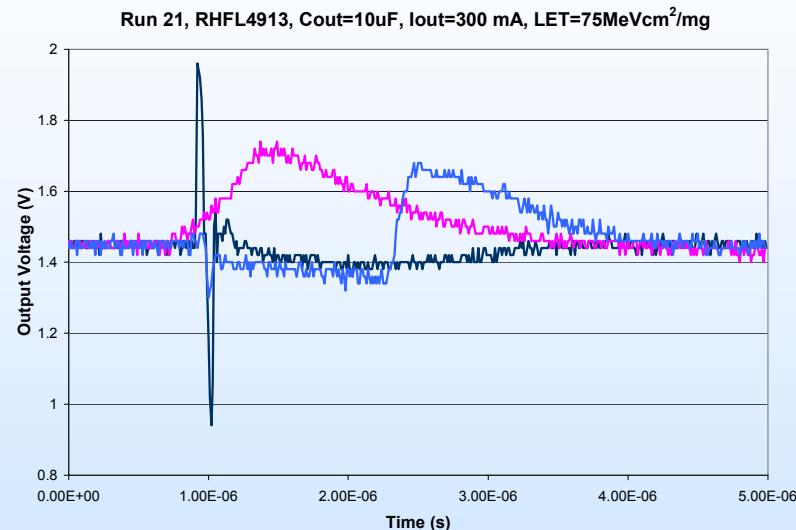
Mitigation, Cout RHL4913



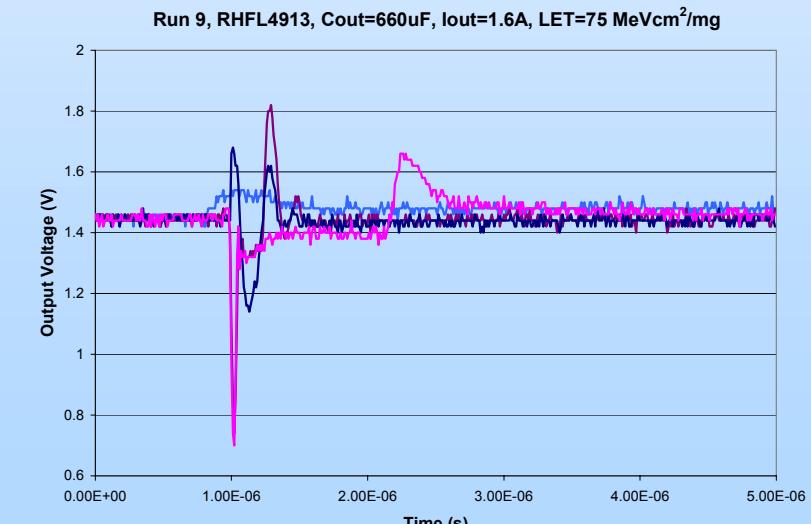
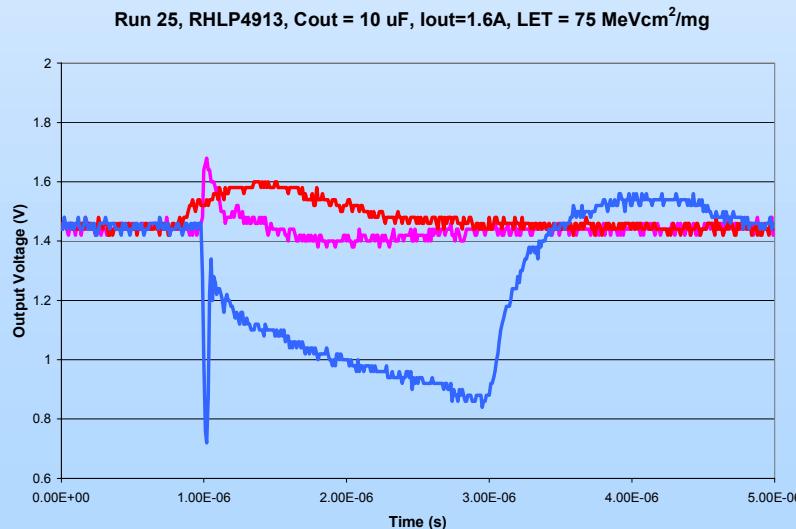
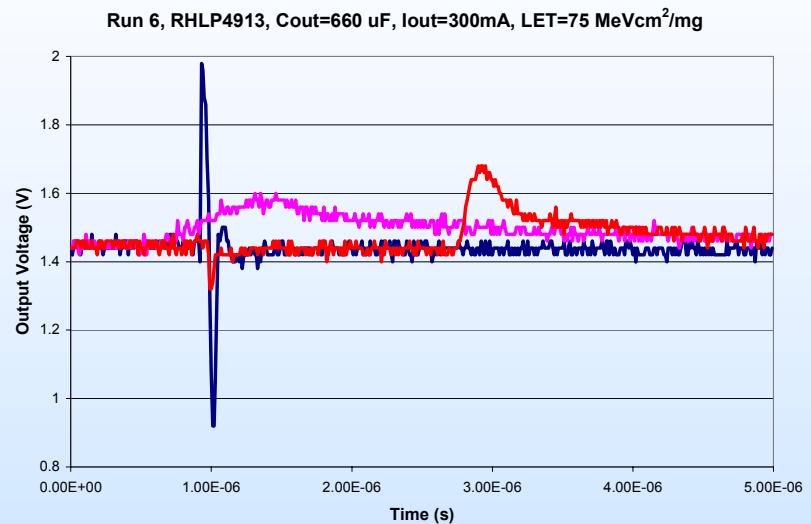


Mitigation, Cout, RHLP4913, SET waveform

Cout=10 μ F

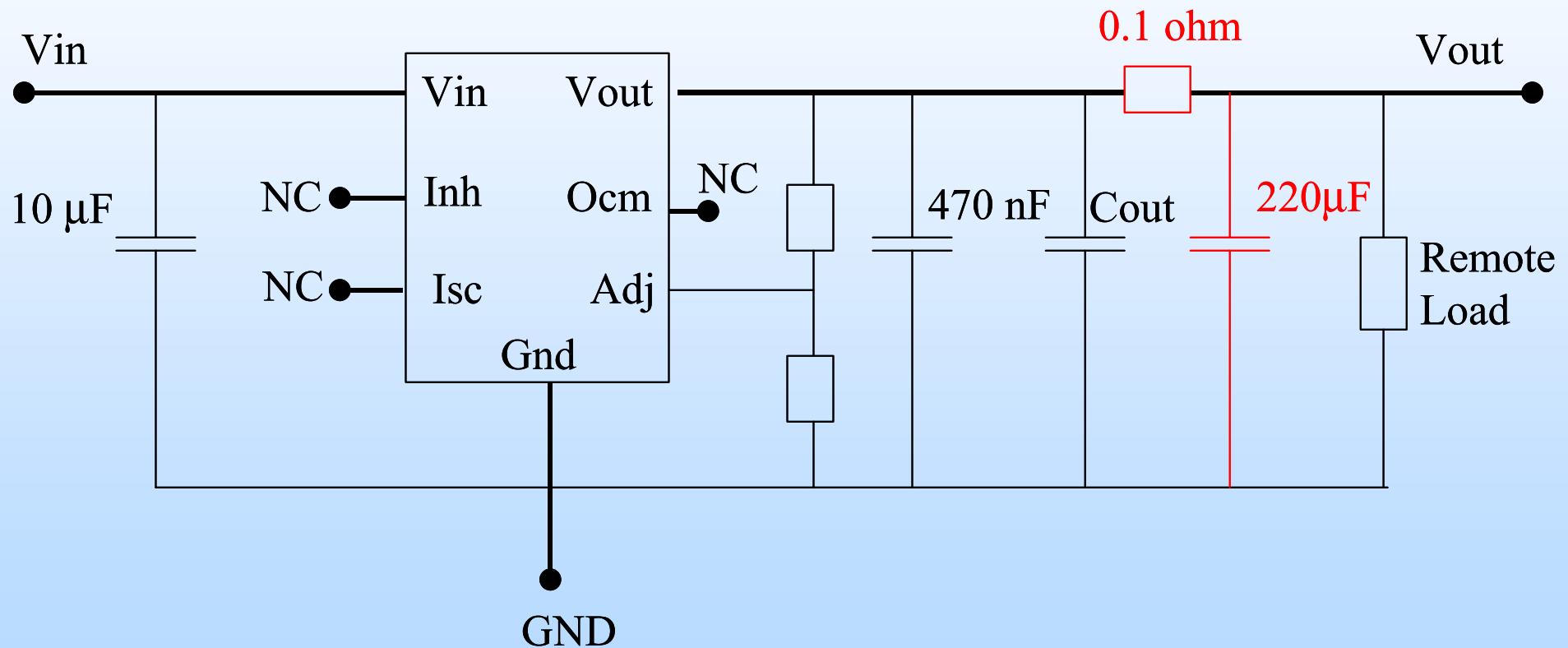


Cout=660 μ F



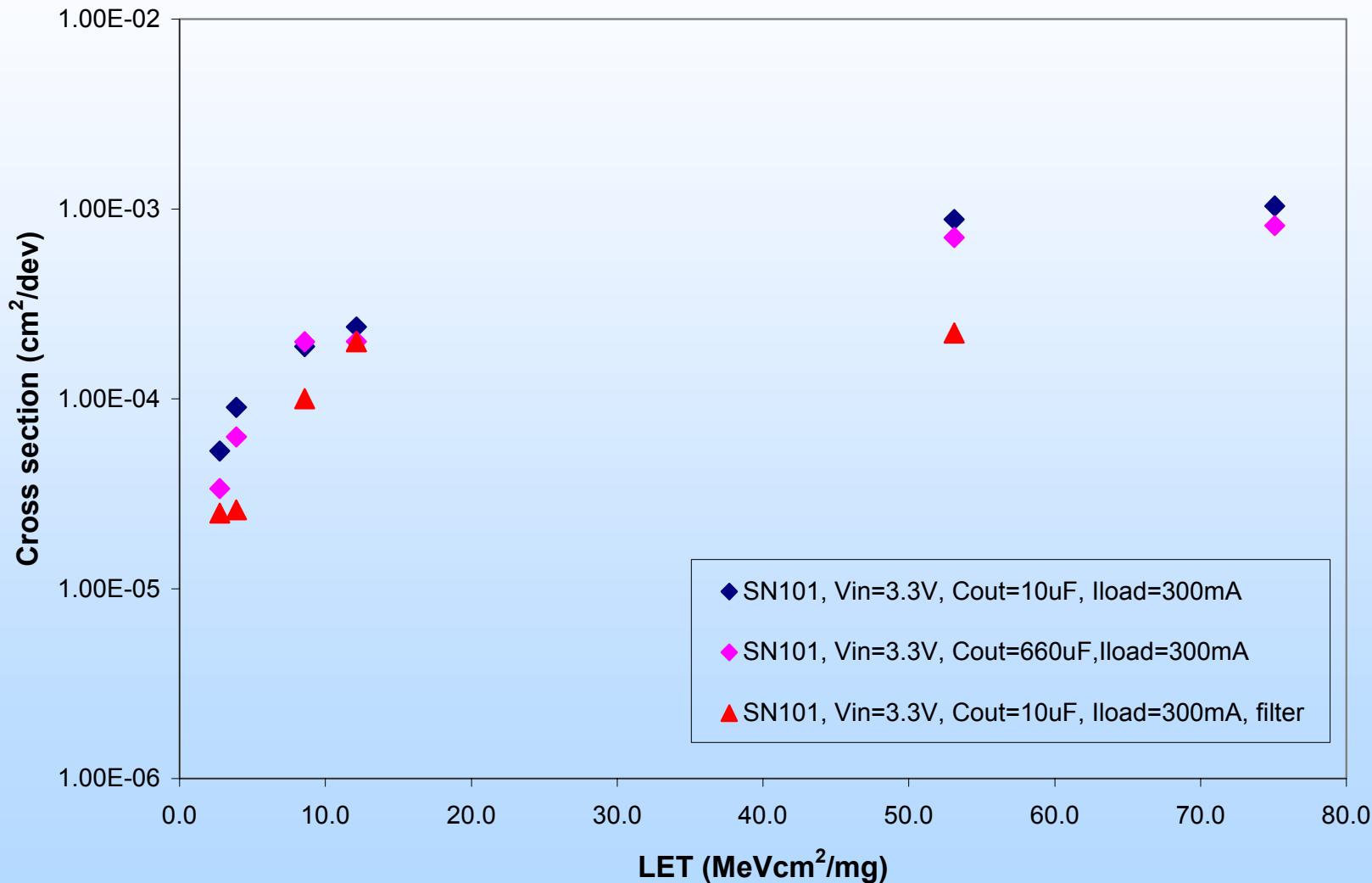


Mitigation, RC filter





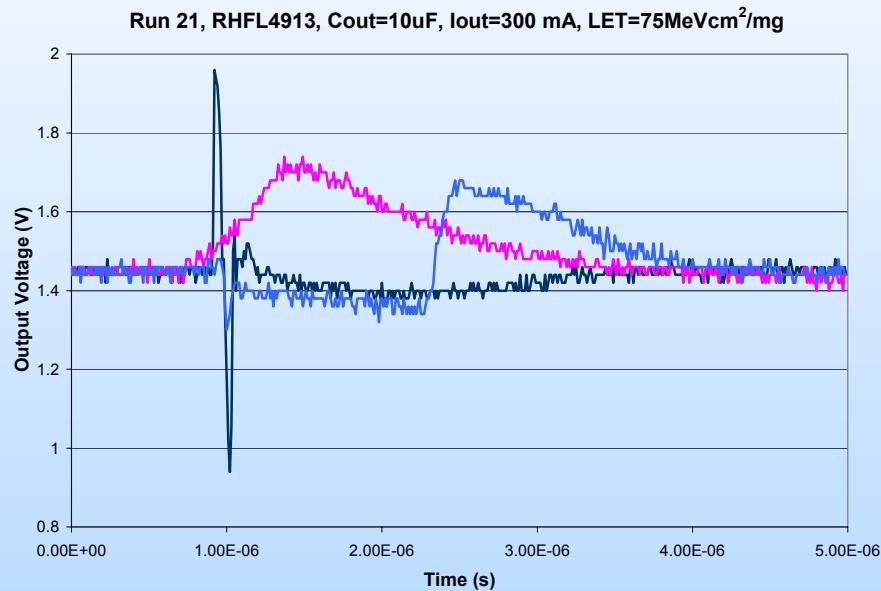
Mitigation, RC filter, RHLP4913



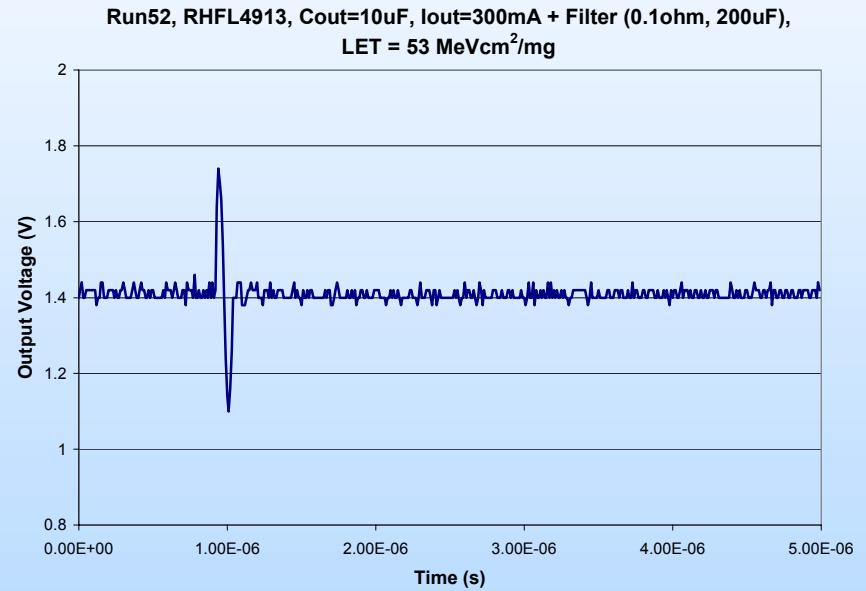


Mitigation, RC filter, RHLP4913 SET waveform

No filter

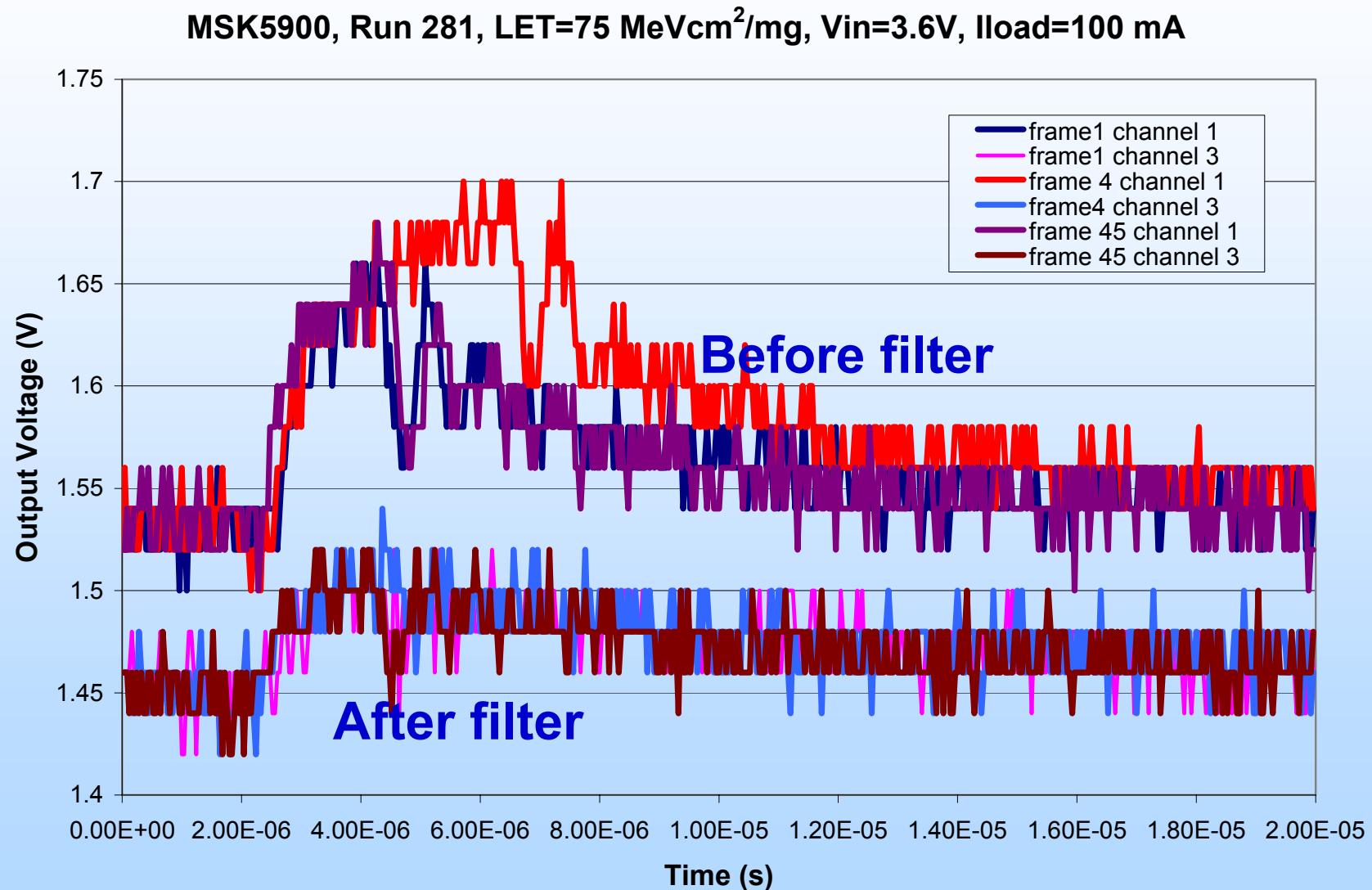


With filter



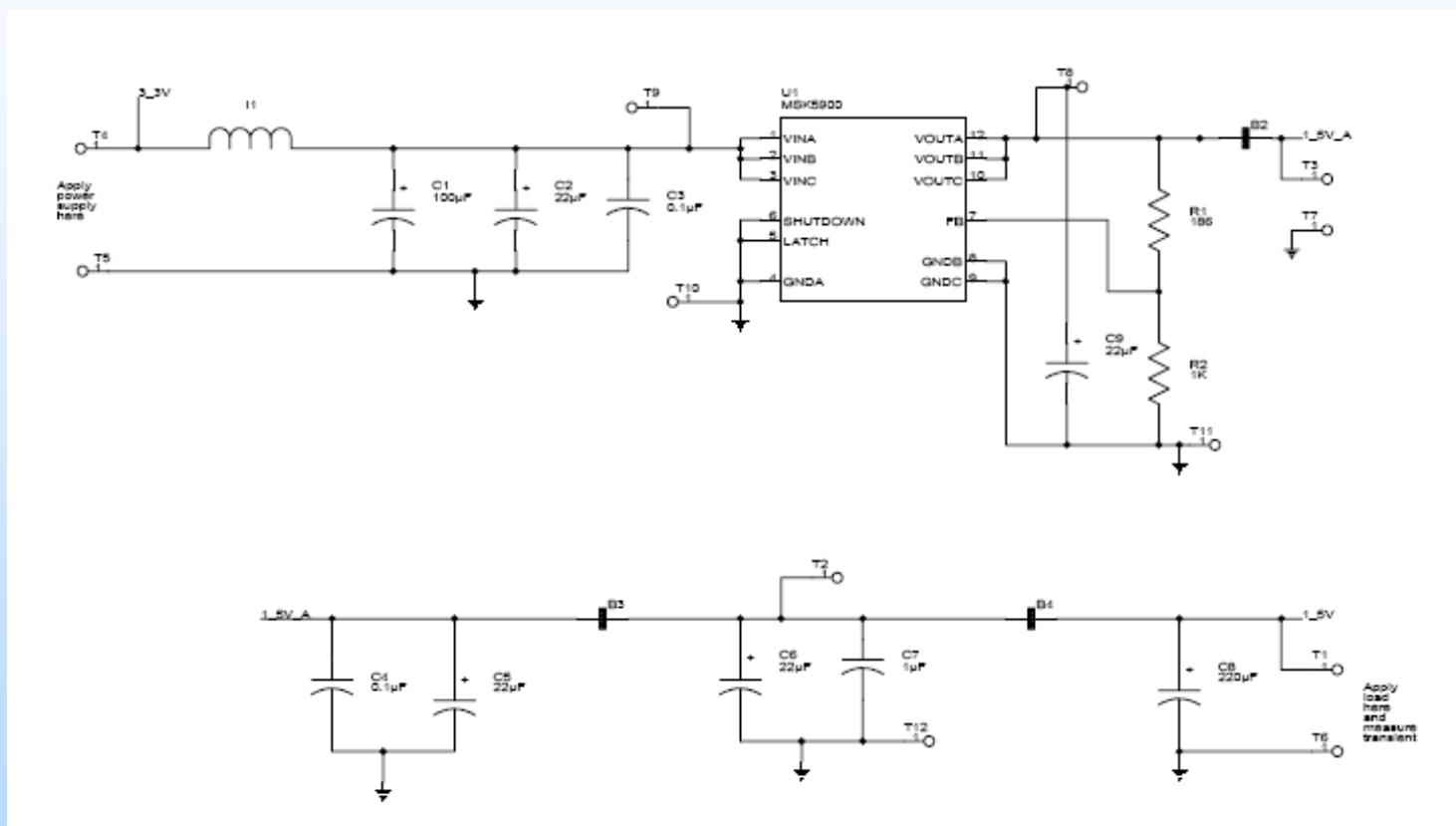


Mitigation, RC filter, MSK5900





Mitigation, LC filter, MSK5900

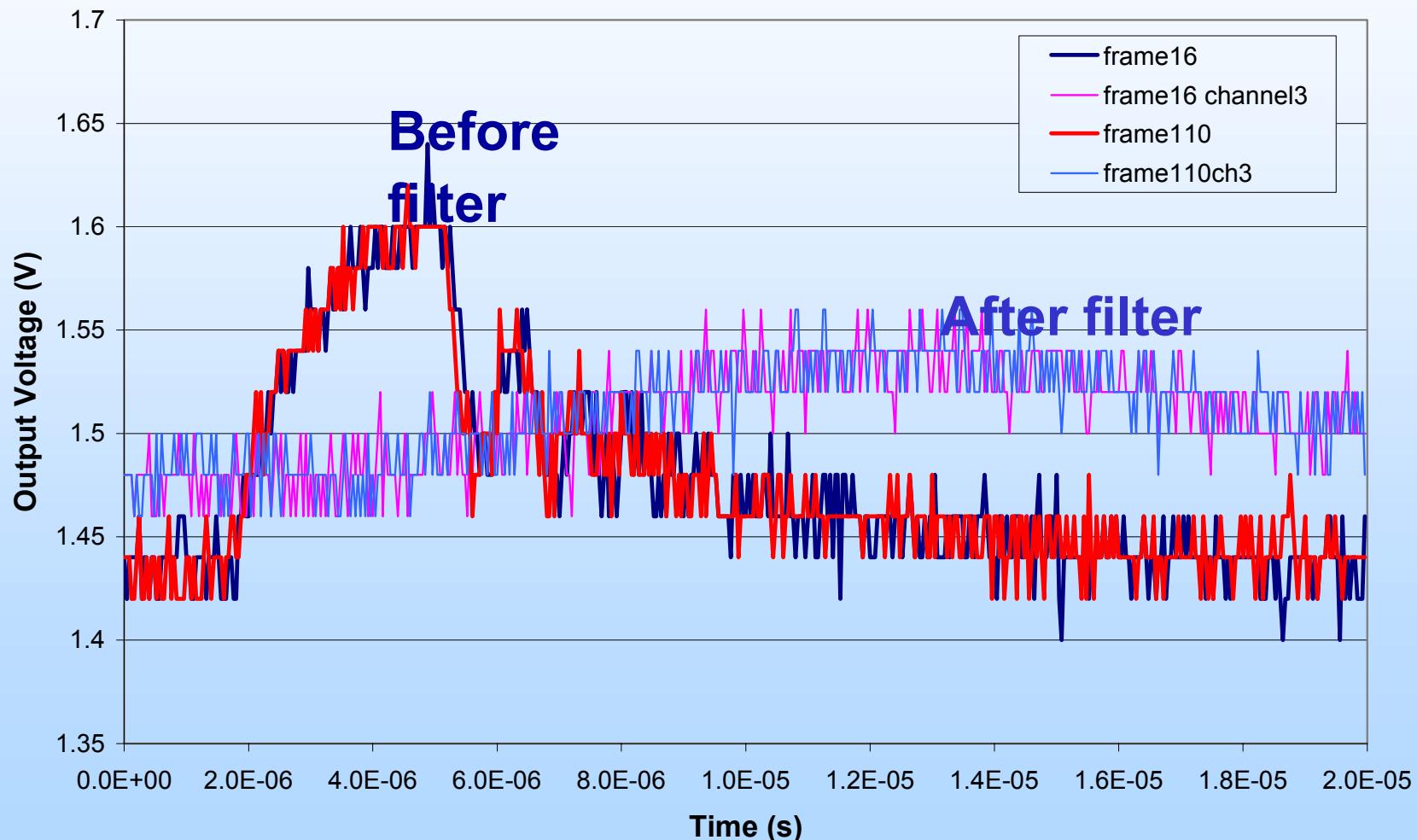




Mitigation, LC filter, MSK5900

SET waveform

Run140, MSK5900, Vin=3.2V, Iout=500mA, LET=28.8MeVcm²/mg





Conclusion

- **SET sensitivity changes significantly from type to type**
- **Worst case bias is different from type to type**
- **Filtering is not effective for short duration transients**